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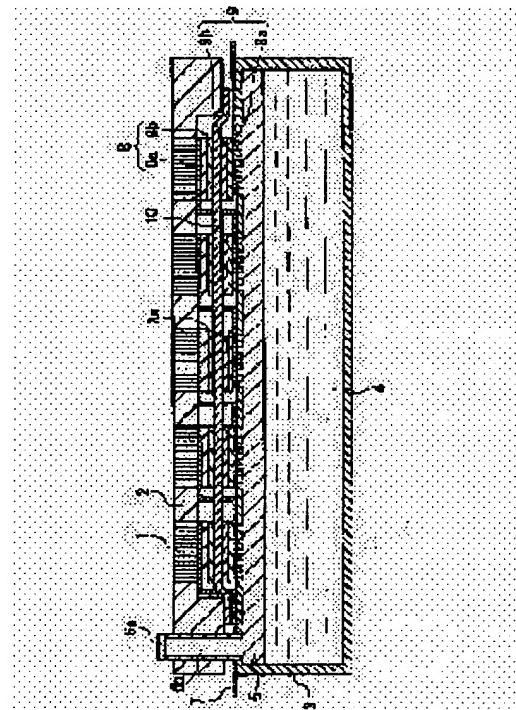
**(21)Application number : 2002-122327**      **(71)Applicant : HITACHI MAXELL LTD****(22)Date of filing : 24.04.2002**      **(72)Inventor : KAYANO HIROSHI**  
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**(54) LIQUID FUEL CELL****(57)Abstract:**

**PROBLEM TO BE SOLVED:** To provide a small liquid fuel cell capable of stably generating power without leaking the liquid fuel.

**SOLUTION:** The liquid fuel cell is provided with a positive electrode reducing oxygen, a negative electrode oxidizing fuel, and an electrode-electrolyte integrated object comprising an electrolyte layer provided between the positive electrode and the negative electrode. A plurality of the electrode-electrolyte integrated objects are provided in the same cell container, and all electrolyte layers of the plurality of electrode-electrolyte integrated objects are formed as a continuous common integrated object. It is provided with a liquid fuel impregnated part impregnated with the liquid fuel, holding the liquid fuel and supplying the liquid fuel to the negative electrode, and a liquid fuel storing part storing the liquid fuel. The liquid fuel storing part is provided with a gas-liquid separating hole having a gas-liquid separating membrane.



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**CLAIMS****[Claim(s)]**

[Claim 1] It is the liquid fuel cell equipped with the electrode, the electrolyte unification object, and liquid fuel which consist of an electrolyte layer prepared between the positive electrode which returns oxygen, the negative electrode which oxidizes a fuel, and said positive electrode and said negative electrode. The liquid fuel cell characterized by being formed as a common unification object with which it had two or more said electrodes and electrolyte unification objects in the same cell container, and all the electrolyte layers of two or more of said electrode and electrolyte unification objects continued.

[Claim 2] The liquid fuel cell according to claim 1 which was equipped with the liquid fuel impregnation section which sinks in, and holds said liquid fuel and supplies said liquid fuel to said negative electrode, and the liquid fuel stores dept. which stores said liquid fuel, and is equipped with the vapor-liquid-separation hole with which said liquid fuel stores dept. has the vapor-liquid-separation film.

[Claim 3] The liquid fuel cell according to claim 2 arranged at the part to which said liquid fuel impregnation section touches said negative electrode.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

[Field of the Invention] This invention relates to the liquid fuel cell which used the liquid as a fuel.

**[0002]**

[Description of the Prior Art] In recent years, as for the rechargeable battery which is the power source, a miniaturization and high capacity-ization are increasingly demanded with the spread of cordless devices, such as a personal computer and a cellular phone. Current and an energy density are high, the rechargeable lithium-ion battery is put in practical use as a rechargeable battery which can attain small lightweight-ization, and need is growing as a portable power source. However, it has not resulted by extent which guarantees continuous duty time amount still sufficient in this lithium secondary battery depending on the class of cordless device used.

[0003] In such a situation, an air cell, a fuel cell, etc. can be considered as an example of the cell which can meet the above-mentioned want. It is thought that an air cell is a cell which uses the oxygen in air as an active material of a positive electrode, and it is a cell suitable in order to make an energy density increase since it can spend the great portion of cell content volume on restoration of a negative electrode. However, since the alkali solution used as the electrolytic solution reacts with the carbon dioxide in air and deteriorates, there is a problem that self-discharge is large in this air cell.

**[0004]**

[Problem(s) to be Solved by the Invention] On the other hand, a fuel is supplied to a negative electrode, a fuel cell reacts to it, and oxygen reacts in a positive electrode. Therefore, if even supply of a fuel and oxygen is performed, it can be used continuously. since [ however, ] the laminating of two or more cells is carried out and it consists of conventional fuel cells -- the cell whole -- \*\* -- it will become high. Moreover, oxygen and a fuel must be circulated to each positive electrode and negative electrode, it must supply, and the accessory vessel for it is needed. For this reason, the conventional fuel cell became large far compared with small rechargeable batteries, such as a lithium ion battery, and there was a problem in using as a small portable power source.

[0005] Here, although an output declines by removing the accessory vessel which circulates oxygen and a fuel compulsorily, the miniaturization of a fuel cell can be attained. However, though oxygen uses the open air in this case, in order that a fuel may not circulate automatically, the structure which can supply a fuel to each negative electrode of a cell is required. Moreover, it is possible that the problem of the carbon dioxide generated at the discharge reaction not piling up in a combustion chamber, or a fuel stopping contacting a negative electrode with consumption of a fuel arises.

[0006] On the other hand, with the structure which arranges two or more electrodes and electrolyte unification objects on the same flat surface, it is possible to make thickness of a cell thin, and since a liquid fuel stores dept. is further sharable, a cell can be miniaturized compared with said laminated structure. however, the closure section for preventing fuel leakage for every electrode and electrolyte unification object with the structure which arranges independently two or more these electrodes and electrolyte unification objects on the same flat surface -- needed -- becoming complicated structurally

\*\*\*\* -- \*\* -- there is a problem of becoming high.

[0007] This invention is made in order to solve said conventional problem, and it does not have the leakage of liquid fuel, and it aims at offering the liquid fuel cell which can be generated stably small.

[0008]

[Means for Solving the Problem] In order to attain said object, the liquid fuel cell of this invention It is the liquid fuel cell equipped with the electrode, the electrolyte unification object, and liquid fuel which consist of an electrolyte layer prepared between the positive electrode which returns oxygen, the negative electrode which oxidizes a fuel, and said positive electrode and said negative electrode. It is characterized by being formed as a common unification object with which it had two or more said electrodes and electrolyte unification objects in the same cell container, and all the electrolyte layers of two or more of said electrode and electrolyte unification objects continued.

[0009] Since the liquid fuel cell of this invention is formed as a common unification object with which all the electrolyte layers of two or more electrode and electrolyte unification objects continued, it becomes unnecessary to prepare the closure section for preventing fuel leakage for every electrode and electrolyte unification object, it can prevent fuel leakage with easy structure, and becomes possible [ also making thickness of a cell thin ]. Moreover, a liquid fuel stores dept. is sharable by arranging an electrode and an electrolyte unification object in the same cell container.

[0010] Moreover, as for the liquid fuel cell of this invention, it is desirable to have had the liquid fuel impregnation section which sinks in, and holds said liquid fuel and supplies said liquid fuel to said negative electrode, and the liquid fuel stores dept. which stores said liquid fuel, and to have the vapor-liquid-separation hole with which said liquid fuel stores dept. has the vapor-liquid-separation film.

[0011] A carbon dioxide etc. can be made to emit from a liquid fuel stores dept., without the carbon dioxide generated at the discharge reaction not piling up in a combustion chamber, and making a fuel spill liquid by having the vapor-liquid-separation hole with which a liquid fuel stores dept. has the vapor-liquid-separation film.

[0012] Moreover, as for the liquid fuel cell of this invention, it is desirable to be arranged at the part to which said liquid fuel impregnation section touches said negative electrode. Since contact to a fuel and a negative electrode is maintained by this even if a fuel is consumed, a fuel can be exhausted to the last.

[0013]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.

[0014] (Operation gestalt 1) The sectional view of the liquid fuel cell of the operation gestalt 1 of this invention is shown in drawing 1. A positive electrode 8 carries out the laminating of diffusion layer 8a which consists of a porous carbon material, and the catalyst bed 8b which consists of carbon powder which supported the catalyst, and is constituted. The positive electrode 8 has the function to return oxygen, and the alloy particle of for example, a platinum particle, iron, nickel, cobalt, tin, a ruthenium or gold, etc. and platinum etc. is used for the catalyst. Moreover, a polytetrafluoroethylene (PTFE) resin particle and a proton exchange resin particle may be contained in catalyst bed 8b. As a proton exchange resin particle, polyperfluoro sulfonic acid type resin, sulfonation polyether sulphone acid resin, sulfonation polyimide resin, etc. can be used, for example. For the reason on a water-repellent disposition, the paste of the carbon powder containing a PTFE resin particle may be applied to the catalyst bed side of diffusion layer 8a.

[0015] The electrolyte layer 10 does not have electronic conduction nature, but is constituted by the ingredient which can convey a proton. For example, the electrolyte layer 10 is constituted by the polyperfluoro sulfonic-acid-type-resin film and the concrete target with the Du Pont "Nafion film", the "deflection myon film" by Asahi Glass Co., Ltd., the "ASHIPU REXX film" by Asahi Chemical Industry Co., Ltd., etc. At others, it can constitute from sulfonation polyether sulphone acid resin film, sulfonation polyimide resin film, sulfuric-acid dope polybenzimidazole film, etc.

[0016] A negative electrode 9 consists of diffusion layer 9a and catalyst bed 9b, and has the function which generates a proton from a fuel, i.e., the function which oxidizes a fuel, for example, can constitute it like a positive electrode.

[0017] The laminating of the above-mentioned positive electrode 8, the above-mentioned negative electrode 9, and the above-mentioned electrolyte layer 10 is carried out, and they constitute the electrode and the electrolyte unification object. That is, the electrode and the electrolyte unification object consist of electrolyte layers 10 prepared between the positive electrode 8, the negative electrode 9, and a positive electrode 8 and a negative electrode 9. Moreover, said electrode and electrolyte unification object are formed as a common unification object with which it had more than one in the same cell container, and all the electrolyte layers of two or more of said electrode and electrolyte unification objects continued. Here, in order that spacing of each electrode and electrolyte unification object may prevent current leak inter-electrode [ adjoining ], its ten to 500 times of the distance (thickness of the electrolyte layer 10) of a positive electrode 8 and a negative electrode 9 are desirable, and considering as ten to 100 times is more desirable.

[0018] The fuel tank 3 in which a fuel 4 is stored is adjoined and established in the electrolyte layer 10 and opposite hand of a negative electrode 9. As a fuel 4, a methanol water solution, an ethanol water solution, wood ether, a sodium-borohydride water solution, a boron hydride potassium water solution, a lithium-borohydride water solution, etc. are used, for example. The fuel tank 3 consists of plastics, such as PTFE, rigid polyvinyl chloride, polypropylene, and polyethylene, and corrosion-resistant metals, such as stainless steel. However, in case a fuel tank 3 is constituted from a metal, it is necessary to introduce an insulator so that each negative electrodes arranged in the same cell container may not short-circuit electrically. Fuel-supply hole 3a is prepared in the part which touches the negative electrode 9 of a fuel tank 3, and a fuel 4 is supplied to a negative electrode 9 from this part. Moreover, the fuel sucking material 5 which sinks in, and holds liquid fuel and supplies liquid fuel to a negative electrode 9 is formed in the interior of the fuel tank 3 including the part which touches a negative electrode 9. Since contact to a fuel 4 and a negative electrode 9 is maintained by this even if a fuel 4 is consumed, a fuel 4 can be exhausted to the last. As fuel sucking material 5, although a glass fiber can be used, by the impregnation of a fuel, a dimension seldom changes, but as long as it is chemically stable, other ingredients may be used.

[0019] The covering plate 2 is formed in the electrolyte layer 10 and opposite hand of a positive electrode 8, and the vent 1 is formed in the part which touches the positive electrode 8 of the covering plate 2. By this, the oxygen in atmospheric air will touch a positive electrode 8 through a vent 1. Fuel [ a vapor-liquid-separation hole-cum- ] restoration opening 6b with the structure which penetrates the covering plate 2 and a fuel tank 3 is prepared in the edge of the covering plate 2. Vapor-liquid-separation film 6a in which desorption is possible is prepared in the fuel tank 3 and opposite hand of this fuel [ a vapor-liquid-separation hole-cum- ] restoration opening 6b. This vapor-liquid-separation film 6a consists of a sheet made from PTFE with pore, and it can make the carbon dioxide generated at the discharge reaction emit from a fuel tank 3, without making a fuel spill liquid. Moreover, it also becomes restoration opening when filling up a fuel by making possible desorption of vapor-liquid-separation film 6a. Fuel [ a vapor-liquid-separation hole-cum- ] restoration opening 6b, the covering plate 2, and the vent 1 consist of the same ingredients as a fuel tank 3.

[0020] From the part which touches the electrolyte layer 10 of a positive electrode 8, and the positive electrode 8 of an opposite hand, it crosses to the part which touches the electrolyte layer 10 of the negative electrode 9 of an adjoining electrode and electrolyte unification object, and the negative electrode 9 of an opposite hand, the charge collector 7 is installed, and the negative electrode 9 of the electrode and electrolyte unification object contiguous to a positive electrode 8 is connected electrically. A charge collector 7 has the role which connects electrically adjoining electrode and electrolyte unification object to a serial, and all the electrode and electrolyte unification objects arranged in in the same cell container are electrically connected to a serial by the charge collector 7. The charge collector 7 consists of noble metals, such as platinum and gold, corrosion-resistant metals, such as stainless steel, or carbon.

[0021] (Operation gestalt 2) The sectional view of the liquid fuel cell of the operation gestalt 2 of this invention is shown in drawing 2. This operation gestalt establishes the fuel-supply way 14 which contains the fuel sucking material 5 inside in some fuel tanks 3, and the fuel-supply way 14 is connected

to the fuel tank 13. The fuel tank 13 is filled up with the fuel 4 like the fuel tank 3, and it has the function which supplies a fuel continuously through the fuel-supply way 14. The fuel tank 13 consists of the same ingredients as a fuel tank 3. The fuel-supply way 14 consists of the same ingredient as a fuel tank 3, rubber of flexibility, such as natural rubber, etc. The fuel restoration opening 12 is formed in the fuel tank 13, and it has the function added and filled up with a fuel. In addition, 11 is a vapor-liquid-separation hole. Other configurations of this operation gestalt are the same as that of the operation gestalt 1 almost.

[0022] (Example 1 of a comparison) The sectional view of the conventional liquid fuel cell of the example 1 of a comparison is shown in drawing 3. Each electrolyte layer 10 of two or more electrode and electrolyte unification objects is not as a continuous common unification object, and the liquid fuel cell of this example 1 of a comparison is the almost same structure as the operation gestalt 1 except gaining separate independence, respectively and being formed.

[0023] (Example 2 of a comparison) The sectional view of the conventional liquid fuel cell of the example 2 of a comparison is shown in drawing 4. The liquid fuel cell of this example 2 of a comparison is the same structure as the example 1 of a comparison except having considered as the structure which has the closure section 15 so that the covering plate 2 may touch the electrolyte layer 10, and prevented the leakage of liquid fuel.

[0024] (Example 3 of a comparison) The sectional view of the conventional liquid fuel cell of the example 3 of a comparison is shown in drawing 5. The liquid fuel cell of this example 3 of a comparison is the almost same structure as the example 2 of a comparison except having made thickness increase in order to make the reinforcement of the covering plate 2 increase.

[0025] When the cell was placed and the existence of fuel leakage was observed so that a vent might turn down after being filled up with the methanol water solution of 3 mass % in the tank of the liquid fuel cell produced as mentioned above, fuel leakage was not seen with the operation gestalt 1 and the operation gestalt 2. However, fuel leakage was seen in the example 1 of a comparison, and the example 2 of a comparison. moreover -- although fuel leakage was not seen in the example 3 of a comparison -- dramatically -- \*\* -- it has high cell structure.

[0026]

[Effect of the Invention] The positive electrode with which this invention returns oxygen as explained above, and the negative electrode which oxidizes a fuel, It is the liquid fuel cell equipped with the electrode, the electrolyte unification object, and liquid fuel which consist of an electrolyte layer prepared between said positive electrodes and said negative electrodes. By considering as the liquid fuel cell currently formed as a common unification object with which it had two or more said electrodes and electrolyte unification objects in the same cell container, and all the electrolyte layers of two or more of said electrode and electrolyte unification objects continued There is no leakage of liquid fuel and the liquid fuel cell which can be generated stably small can be offered.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

[Drawing 1] It is the sectional view of the liquid fuel cell of the operation gestalt 1 of this invention.

[Drawing 2] It is the sectional view of the liquid fuel cell of the operation gestalt 2 of this invention.

[Drawing 3] It is the sectional view of the liquid fuel cell of the conventional example 1 of a comparison.

[Drawing 4] It is the sectional view of the liquid fuel cell of the conventional example 2 of a comparison.

[Drawing 5] It is the sectional view of the liquid fuel cell of the conventional example 3 of a comparison.

**[Description of Notations]**

- 1 Vent
- 2 Covering Plate
- 3 Fuel Tank
- 3a Fuel-supply hole
- 4 Fuel
- 5 Fuel Sucking Material
- 6a Vapor-liquid-separation film
- 6b Fuel [ a vapor-liquid-separation hole-cum-] restoration opening
- 7 Charge Collector
- 8 Positive Electrode
- 8a Diffusion layer
- 8b Catalyst bed
- 9 Negative Electrode
- 9a Diffusion layer
- 9b Catalyst bed
- 10 Electrolyte Layer
- 11 Vapor-Liquid-Separation Hole
- 12 Fuel Restoration Opening
- 13 Fuel Tank
- 14 Fuel-Supply Way
- 15 Closure Section

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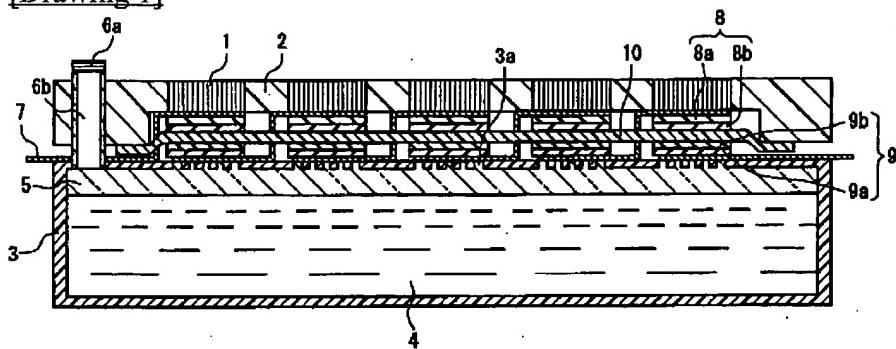
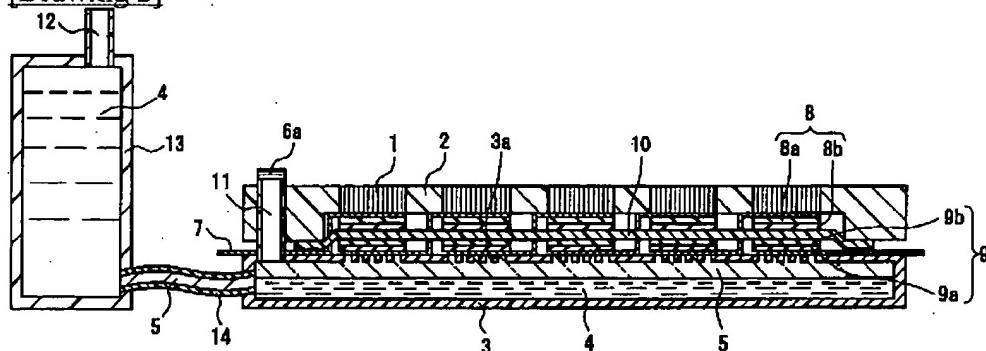
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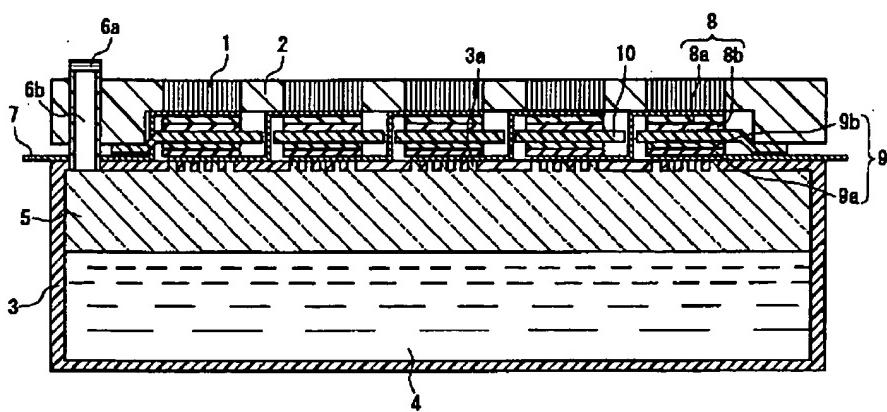
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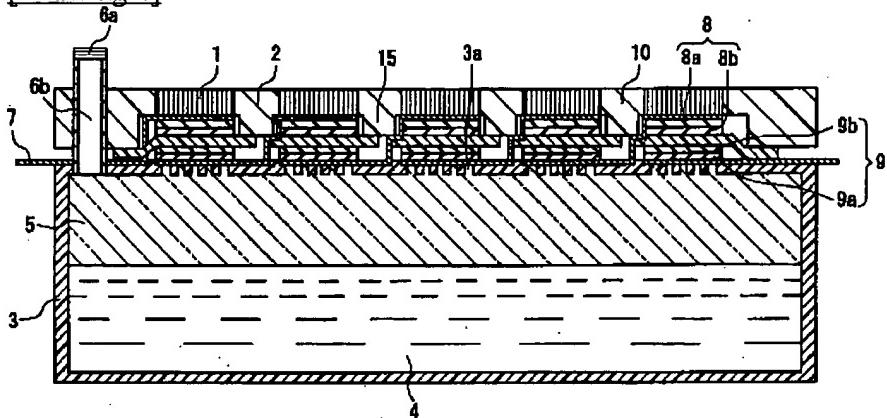
**DRAWINGS**

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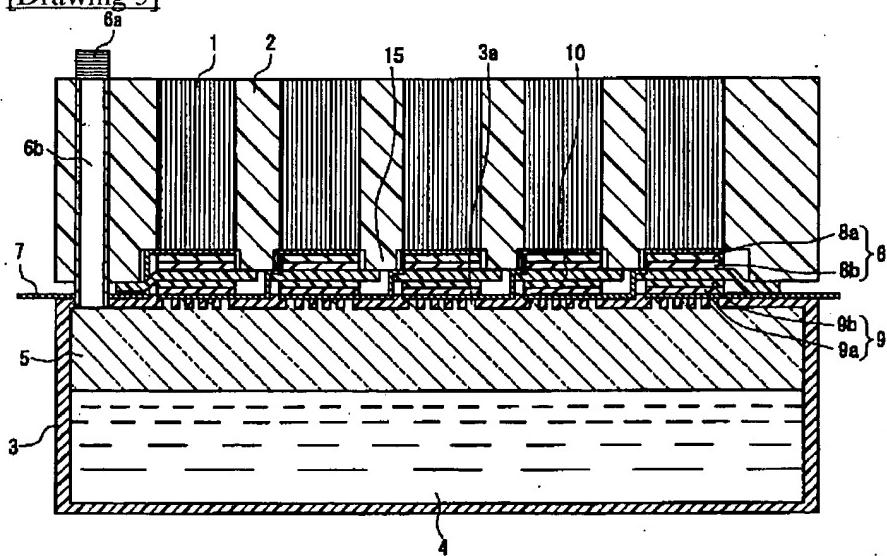
**[Drawing 1]****[Drawing 2]****[Drawing 3]**



[Drawing 4]



[Drawing 5]



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